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A NEW SPECIES OF CONCHOSTRACAN FROM THE LOWER CRETACEOUS OF VICTORIA

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Abstract

Cyzicus (?) *branchocarus* sp. nov., the first Mesozoic conchostracan to be found in Victoria, is described from abundant material from Lower Cretaceous (Valanginian-Aptian) sediments of the Korumburra Group near Koonwarra, Victoria. Problems of stratigraphic nomenclature and of generic classification of Conchostraca are discussed.

Introduction

Straightening of the South Gippsland Highway by the Victorian Country Roads Board in 1961 lead to the discovery of abundant plant and fish remains in Lower Cretaceous sediments intersected in a new road cutting 1·5 miles W. of Tarwin and 2·5 miles E. of Koonwarra, 93·5 miles by road SE. of Melbourne. The locality is 11·5 chains W. of the NE. corner of allotment 87, parish of Leongatha. Due principally to the enthusiasm of Mr J. M. Bowler, large-scale collecting was carried out by the Geology Department, University of Melbourne and, subsequently, by personnel of the National Museum and the Geological Survey of Victoria. In addition to abundant fish and plant remains, the horizon has yielded an abundance of insects, principally larvae (Carroll 1962), a limulid, and abundant, generally poorly preserved, conchostracans. The plant remains are presently being described by Miss Elizabeth Carroll of the University of Melbourne; the insects are to be described by Mr Edgar Rick of the Division of Entomology, Commonwealth Scientific and Industrial Research Organization.

The conchostracans and associated fauna occur typically in claystones forming the upper parts of beds of felspathic siltstone 4 to 5 mm thick grading upwards to finely banded claystone. Fossils have been collected through a thickness of approximately 10 ft stratigraphically. The sediments represent a small lacustrine or paludal development in the vast thickness (10,000+ ft) of Lower Cretaceous rocks outcropping across S. Victoria in five principal outcrop tracts. Each of these outcrop tracts has received a formal stratigraphic name (Medwell 1954): Merino Group, Otway Group, Barrabool Sandstone, Tyers Group, and Korumburra Group (senior synonym of Strzelecki Group), though in all cases formal subdivision has yet to be worked out in satisfactory agreement with the requirements of the Australian Code of Stratigraphic Nomenclature. The slight differences in lithology between each of these occurrences compared with vertical variation within each belt of sediments, the relative monotony of the macro- and microfloras (Medwell 1954; Dettmann 1963), the short interval of time involved, and the virtual continuity sub-surface between the various outcrop tracts are making it increasingly difficult to apply a separate nomenclature for each outcrop tract and, at the same time, strive towards an overall understanding of the structural and stratigraphic evolution of the State in Cretaceous times. Should one all-embracing group name be deemed desirable, then the oldest formally defined name, Korumburra Group (Stirling 1899, p. 54), could be redefined to embrace the entire belt of surface and sub-surface non-marine Lower Cretaceous sediments of S. Victoria.

Previously recorded invertebrate faunas of the Korumburra Group, away from Koonwarra, considered in this extended sense, are restricted to rare finds of *Unio*-like lamellibranchs (Stirling 1892, McMichael 1956). Vertebrate remains consist merely of records of a dinosaur claw and a tooth of *Ceratodus* from Cape Patterson (Woodward 1906, 1907), two fishes from Casterton (Hall 1899), and a dipnoan scale from Kirrak (Chapman 1912).

Conchostraca are typically inhabitants of ephemeral waters, but occur rarely even in large rivers such as the Danube and Yenisei. Records of them being found fossil in association with marine faunas consist of single specimens obviously washed into marine or paralic environments (cf. Kobayashi 1954, p. 52-55). The presence of a limulid in association with conchostracans is not necessarily anomalous, for the habitat of the living *Carcinoscorpius* includes virtually fresh water. Microplankton have not been found within the Korumburra Group of S. Victoria, but their presence in bores in the vicinity of the South Australian border (Hodgson 1964, Douglas 1964) and at Duck Bay in E. Victoria (Evans & Hodgson 1964) may indicate an approach to quasi-marine environments in these directions. Faunal and floral evidence elsewhere indicates accumulation of the Korumburra Group in non-marine environments.

The collections used for the present description were amassed principally by Miss Marjorie Hall, Mrs I. Knight, and Mr J. G. Douglas of the Mines Department of Victoria, supplemented by extensive collections generously put at my disposal by Mr Peter Duncan of the State Electricity Commission of Victoria. I am indebted to them, to Mr Philip Bock for his care with the photographs, to Professor C. M. Tattam, Dr G. A. Thomas, and Mr J. M. Bowler for access to collections made by the University of Melbourne, to Mr E. D. Gill for access to collections made for the National Museum of Victoria, to Dr D. E. Thomas, Director of Geological Survey, for permission to publish, and to Professor Akira Hase of Hiroshima University for the generous gift many years ago of representative polymorphic conchostracans from the Cretaceous Yamaji Shale of the Kwanmon Group of Japan, and of an annotated translation of his paper on these forms (Hase 1948).

Systematic Description

Order CONCHOSTRACA Sars

If we omit consideration of forms having spinose dorsal margins (e.g. *Vertexia* Lutkevich), umbonal spines (e.g. *Echinestheria* Marlière) or radial ornament (Estheriellidae, Leaiadidae), the features available for generic classification of fossil conchostracans virtually reduce to carapace shape (including position and prominence of the umbo), microscopic ornament, and density of growth segments. Because of wide intraspecific variation in these characters, the classification of living conchostracans has relied chiefly on the structures of the head and appendages. This has been stressed by the most prolific workers on living forms (e.g. Daday de Dées 1915-27, Botnariuc 1945), Daday going so far as to stress the impossibility of discriminating between species of *Leptestheria* on carapace characteristics alone: 'Notons encore que, pour la caractéristique des espèces, on ne peut que rarement utiliser la forme des valves et la structure de leur surface à cause de la variabilité d'individu à individu; d'autres caractères doivent être pris en considération: la forme du rostre des mâles, la structure des 10^{e}-14^{e} paires de pattes des femelles, celle du bord dorsal du telson, de la face dorsal des segments postérieurs; sans la connaissance exacte de ces particularités il serait impossible de distinguer les *Leptestheria* les uns des autres.'

Fossil conchostracans are particularly subject to deformation and are often found in a crumpled state; discrimination of species and genera on form alone therefore becomes increasingly difficult and tends to result in long lists of subfamilies, genera, and species based on forms which may well be conspecific. Studies such as those of Hase (1948), Marlière (1950), Feys (1954), and Housa & Spinar (1962) are sobering in this regard. Other workers (e.g. Raymond 1946; Novozhilov 1954, 1956, 1958, 1960; Kobayashi 1954) have adopted a more liberal attitude to secondary deformation in endeavouring to discriminate stratigraphically useful forms. Nevertheless, bearing in mind the previously cited examples of extreme variation due to post-mortal deformation and of wide variation in the carapace of living forms such as that documented for *Leptestheria dahalacensis* (Rüppell) (Daday de Dées 1923, Fig. 99), it would seem wisest to avoid basing new fossil genera and family-groups on carapace characteristics that are identical with or approximate those of living forms. Accordingly, the majority of nondescript fossil Conchostraca can be referred to the Cyzicidae, Leptestheriidae, Imnadiidae, Limnadiidae, Limnadiopseidae, and Cyclestheriidae, families based in the first instance on living forms. Gross shell morphology can be applied in discriminating between the last four families, but there is pronounced overlap in the broad morphology of the carapaces of the Cyzicidae and Leptestheriidae. There is, however, almost complete dichotomy in sculpture of the growth segments between these two families, various reticulate patterns indicating Leptestheriidae, and punctate to maculate and radiate patterns indicating Cyzicidae. Because, in the present instance, I have not been able to show significant differences in carapace between the form under discussion and the living cyzicids, I have referred it to that family and doubtfully to the genus *Cyzicus*, 19 out of 20 species of which have punctate to maculate microsculpture. Had the microsculpture been reticulate like that of the well known *'Estheria' minuta* Goldfuss (e.g. Bock 1953, Reible 1962), its affinities would have been best indicated by queried reference to *Leptestheria*, the typical and most numerous genus of the Leptestheriida. A case can be made for tentatively referring forms with radiate ornament to the cyzicid genus *Caenestheriella*, for 12 of the 13 living species with this type of ornament were referred to that genus by Daday de Dées in his monograph of the living Conchostraca. This method is only a partial solution to the problem of dealing with fossil cyzicid and leptestheriid conchostracan carapaces which only partially reflect the diagnostic characters of the animal.

Family CYZICIDAE Stebbing 1910

Genus **Cyzicus** Audouin 1837

Cyzicus (?) **banchocarus** sp. nov.

(Pl. 26, fig. 1-11; Fig. 1)

DIAGNOSIS: A moderate-sized cyzicid conchostracan having an initial disc about 0·4 or 0·6 mm high, with 14 or 15 growth bands at a height of 3·5 mm [length 5·0 mm], with fine marginal growth lines in adult specimens and with punctate ornament of the growth bands.

TYPES: Holotype Geol. Surv. Vict. 58560; paratypes Geol. Surv. Vict. 58555-58559, 58561-58565.

DESCRIPTION: Carapace gently convex, sub-oval with nearly straight dorsal margin extending for half the length of the carapace; antero-dorsal margin feebly curved, anterior, ventral and posterior margins evenly curved with postero-dorsal margin rounding into the dorsal margin at an angle of about 140° in carapaces about 1 mm in length, becoming more oblique in mature shells to as low as 160° (e.g. Pl. 26, fig. 5); umbo not projecting above the dorsal margin, located at 23-28% of the length from the anterior end of the carapace; initial disc seemingly about 0·6 mm high with indications of a growth line on some at about 0·4 mm and on others at distances between 0·7 and 0·9 mm; growth bands concentric except for the dorsal margin, delineated by a distinct depression with a hair-line ridge on the inner surface and a corresponding broad ridge on the exterior; growth bands numbering about 15 on a specimen 5·2 mm long and 3·8 mm high, with a maximum of 18 bands; surface of bands on most material smooth with, on large specimens, fine concentric lirae on marginal bands and rarely elsewhere, but on well preserved specimens having fine punctae, 0·003 mm in diameter, spaced 2 or 3 times this diameter apart.

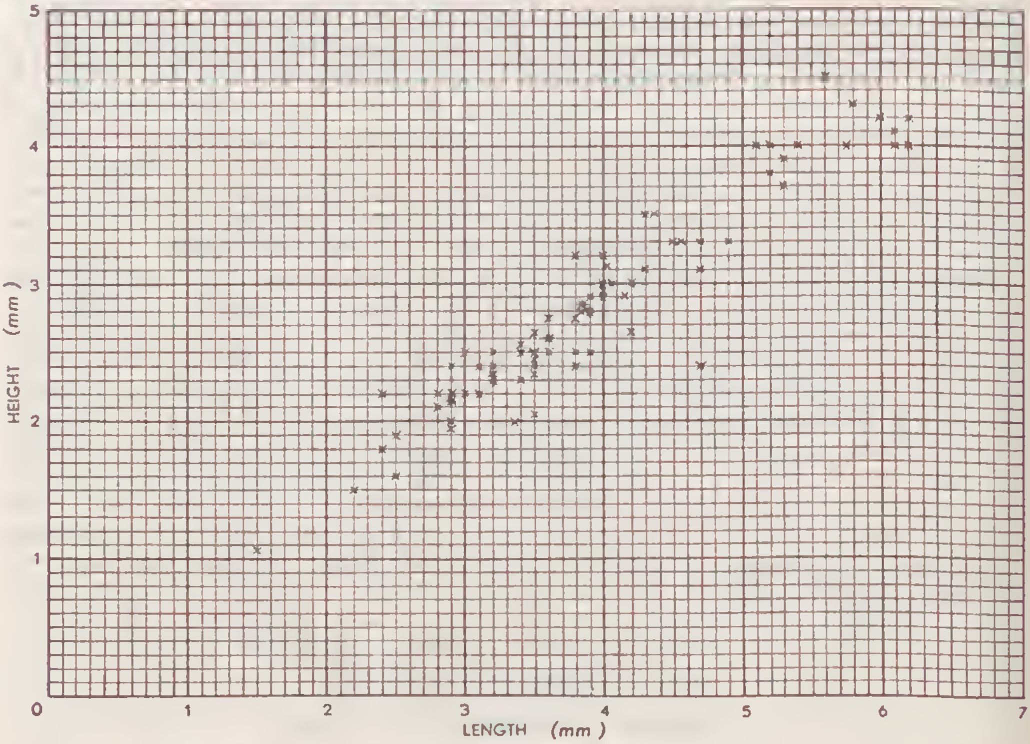

FIG. 1—Dimensions of *Cyzicus* (?) *banchocarus* sp. nov. All specimens from the N. side of the South Gippsland Highway 11·5 chains W. of the NE. corner of allotment 87, parish of Leongatha.

DIMENSIONS: Because of the abundance of material, the dimensions of 65 complete specimens are plotted as Fig. 1. The largest specimen is 6·2 mm long and 4·2 mm high; the smallest specimen 1·5 mm long and $1{\cdot}0_5$ mm high with a fairly even spread between these limits. Growth stages occur in one well preserved $2{\cdot}6_1$ mm, but there is considerable variation between specimens due in part to specimen at about 0·4, $0{\cdot}5_3$, $0{\cdot}6_8$, $0{\cdot}8_5$, $1{\cdot}0_4$, $1{\cdot}2_5$, $1{\cdot}5_2$, $1{\cdot}8_4$, $2{\cdot}1_2$, $2{\cdot}3_2$, and deformation.

DISCUSSION: The available material is distorted and crumpled to varying degrees, but the distortion is much less than generally met with in the Palaeozoic and Mesozoic conchostracan faunas elsewhere. One specimen with the two parts of the carapace oriented at right angles has a 7% difference in dimensions. Earlier instars tend to be obscure or indiscernible on most specimens and in extreme cases growth segments cannot be made out on the carapaces. The growth segments are normally smooth, but a few specimens (e.g. GSV 58564) show regularly spaced minute pin-prick-like punctae, so there is reasonable certainty that the original surface of this species was minutely punctate like living species of *Cyzicus*. Except for its smaller size and less protruding umbo, *C.* (?) *banchocarus* is very much like the living *Cyzicus tetracerus* Krynicki (e.g. Botnariuc & Orghidan 1953, Fig. 16), the types species by monotypy of *Cyzicus* Audouin (Talent 1958).

There are no previous descriptions of Cretaceous or Jurassic conchostracans from Australia, but 13 species of Permian and Triassic conchostracans have been described under the generic name *Estheria* from Queensland and New South Wales (Mitchell 1927). In recent years, these have been relocated generically and some of them have been split (Novozhilov 1958) on the basis of published illustrations. In the following discussion, questions of deformation and possible synonymy are omitted; recent generic placements are indicated in brackets. *E. ipsviciensis* Mitchell [*Pseudestheria* Raymond 1946, *Euestheria* Kobayashi 1954] from the Triassic of Queensland resembles *C.* (?) *banchocarus* in general size, proportions, rounded dorsal margin, and absence of reticulate ornament from the growth bands. The umbo does not protrude above the dorsal margin, but mature specimens of *E. ipsviciensis* have 22 or more growth bands compared with 12-16 in the present form. *E. coghlani* Etheridge [*Palaeolimnadia* Raymond 1946, *Euestheria* (?) Kobayashi 1954, *Belgolimnadia* Novozhilov 1958 in part] has similar concave growth bands but a more arcuate dorsal margin. Younger forms of *C.* (?) *banchocarus* (e.g. Pl. 26, fig. 4, 5) resemble *E. glenleensis* Mitchell [*Palaeolimnadia* Raymond 1946, Novozhilov 1954, *Estheriina* Kobayashi 1954], but the copious material available for *C.* (?) *banchocarus* shows these to be earlier growth stages rather than a matter of different genera. *E. novocastrensis* Mitchell [*Pseudestheria* Raymond 1946, Novozhilov 1954, *Euestheria* Kobayashi 1954] is considerably larger than *C.* (?) *banchocarus*, has a well defined postero-dorsal angulation, and straighter dorsal and antero-dorsal margins. *E. trigonellaris* Mitchell [*Pseudestheria* Raymond 1946, *Euestheria* Kobayashi 1954] has similar ornament to *C.* (?) *banchocarus*, but the umbo protrudes above the dorsal margin and is less anteriorly situated. *E. obliqua* Mitchell (? synonym of *E. novocastrensis*) [*Pseudestheria* (?) Raymond 1946, *Pseudestheria* Novozhilov 1954, 1958, *Euestheria* Kobayashi 1954] is of larger size and has a straighter dorsal margin. *E. lata* Mitchell (= *Cyclestheria mitchelliana* Novozhilov 1958 in part) [*Pseudestheria* Raymond 1946, *Euestheria* Kobayashi 1954] has similar well rounded margins but is proportionately higher. *E. belmontensis* Mitchell [*Pseudestheria* Raymond 1946, *Lioestheria* (?) Kobayashi 1954, *Glyptoasmussia* Novozhilov 1958] has a straighter dorsal margin, is proportionately higher, and has somewhat more (19-20) growth bands. *E. linguiformis* [? *Palaeolimnadia* Raymond 1946, *Estheriina* Kobayashi 1954] has similar proportions, but a straighter dorsal margin and a much more oblique carapace than *C.* (?) *banchocarus*.

The Mesozoic conchostracans of Asia have been described principally by Y. S. Chi (1931), N. Novozhilov (1954, 1958), T. Kobayashi and co-workers (principally 1942, 1947a, 1947b, 1951, 1953, 1954), H. Kusumi (1960), W. T. Chang (1957a & b) and by Chang & P. C. Chen (1964). *Estherites shimamurai* Kobayashi from the possible late Triassic of Jehol and North Korea and *Estheria zeili* Mansuy from the late Triassic or early Jurassic of Laos have similar shape, size, and density of growth bands to *C.* (?) *banchocarus* but bear reticulate ornament (Kobayashi 1951, Mansuy 1912). The later Mesozoic conchostracan faunas of Asia are dominated by forms bearing reticulate to radiate microsculpture (e.g. Chang & Chen 1964) and therefore, in general, do not resemble *C.* (?) *banchocarus. Pseudestheria turfanensis* Novozhilov (= *Estheria singkiangensis* Chi in part) from Mongolia and Sinkiang has a straighter dorsal margin, more oblique carapace and is much larger than *C.* (?) *banchocarus. P. concinna* Novozhilov could be construed as a near synonym of *C.* (?) *banchocarus* were it not for its reticulate ornament and more defined postero-dorsal angulation. *Estherites endoi* Kobayashi & Kido from Manchuria has punctate to radiate growth bands but differs in being much larger and in bearing a greater number of growth bands (20-30). *E. kyöngsangensis paucilineata* Kobayashi & Kido likewise has a similar general shape to *C.* (?) *branchocarus* but is somewhat larger and has its growth bands ornamented by radial lirae.

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Explanation of Plate

Plate 26

Cyzicus (?) *banchocarus* sp. nov. 1-3—large paratypes, GSV 58555, 58556, and 58557 respectively, × 11, showing varying preservation of growth segments; these typically fade out towards the postero-lateral margin and become indistinct on the umbo. 4, 5—counterpart paratypes GSV 58558 and 58559 respectively, × 9, showing the progressive increase in the angle by which the postero-dorsal margin rounds into the dorsal margin. 6—holotype internal mould GSV 58560, × 11, with low lighting to show the concave growth segments and the fine ridges on the interior at the junction of each pair of growth segments. 7—paratype GSV 58561, × 9, showing crumpling and exaggeration of growth segments associated with lateral compression. 8, 9—paratypes GSV 58562 and 58563, × 11 and × 10 respectively, showing varying preservation; fig. 9 showing two crumples, due to deformation of the carapace, mimicking the radii of *Leaia* Jones. 10—enlargement of part of the surface of paratype GSV 58564, × 40, showing minutely punctate surface texture. 11—enlargement of part of surface of paratype GSV 58565, × 50, showing uneven preservation of the minutely punctate surface ornament. All specimens are in the collections of the Geological Survey of Victoria, Mines Dept, Melbourne. Photographs are by Mr P. E. Bock.